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NORTH CAROLINA SCIENTIST TO SERVE ON POTOMAC RIVER WATER QUALITY PANEL

Dr. Hans W. Paerl, Associate Professor at the UNC Institute of Marine Sciences, Morehead City, has been chosen to participate on an EPA-D.C. Council of Governments supported blue-ribbon panel charged with identifying causes and future water management strategies aimed at stemming bloom events plaguing water quality in our nation's capital. Dr. Paerl is currently engaged in Water Resources Research Institute-supported studies identifying environmental factors leading to nuisance blue-green algal blooms in the Neuse River and formulating nutrient input constraints designed to minimize future bloom events. The organism responsible is *Microcystis aeruginosa*, a notorious scum-forming species, which can at time prove toxic to animal consumers of river water supplies. This species is also responsible for recurring bloom events in the Potomac River. During the summer of 1983, much of the lower river, including segments in Washington, DC, was adversely affected by such blooms.

Because of information and experience Dr. Paerl has gained with respect to Neuse River bloom dynamics and potential management remedies, he has been asked to assist the Potomac River Panel. It is expected that this panel will utilize national expertise, including pilot work being conducted in North Carolina. A set of management strategies and future research priorities will be presented by the panel at the end of 1984.

POLLUTION PREVENTION PROGRAM GETS UNDERWAY AT NRCD

The Pollution Prevention Pays approach to minimizing pollution, a concept designated as the primary waste management strategy for use by state agencies in North Carolina, is at the center of a new program in the N. C. Department of Natural Resources and Community Development. The Pollution Prevention Pays Program in the Division of Environmental Management will be directed by Roger Schecter, formerly with the N. C. Division of Natural Resources Planning and Assessment. A work plan has been drafted that covers a variety of approaches to promoting the PPP philosophy.

This philosophy holds that it is economically as well as environmentally advantageous to reduce pollutants at the source rather than to rely on expensive end-of-line treatment processes and large waste-disposal needs. For example, industries, by modifying their production processes, can cut down on the amount of waste they release to the environment and at the same time save money (e.g., through reduced chemical use and lowered waste-disposal costs).

The Division of Environmental Management is seen as the logical center for the PPP program. Through its water, air, and groundwater programs DEM has daily contact with industries, local government, and citizens as well as direct ties to other pertinent state agencies. These include the Department of Human Resources (which regulates

solid and hazardous waste), the Department of Commerce (which works with new industries), the Governor's Waste Management Board, and the N. C. Board of Science and Technology.

According to DEM, "the program will institutionalize a positive public/private partnership to promote environmental quality and economic growth." Instead of the often-adversarial relationship between the regulators and the regulated, the program will encourage cooperation.

Objectives of the program are outlined in a draft work plan:

1. Establish an information clearinghouse. References relating to pollution prevention will be obtained, reviewed, and categorized by Standard Industrial Code process, and EPA Waste Code as appropriate.
2. Specify ways to incorporate pollution prevention information and philosophy into all program activities. Specific ways and procedures will be developed to help exchange information with industries and municipalities in such areas as water quality discharge and air quality permits, pretreatment programs, industrial revenue bond reviews, facilities planning, groundwater monitoring, and compliance monitoring.
3. Categorize all regulatory documents by Standard Industrial Code. DEM's computerized permits tracking system will be modified to include the respective SIC reference where possible. This will, among other things, help match information from the clearinghouse to a particular industrial user.
4. Hold training sessions in Raleigh and each DEM regional office on pollution prevention technologies, applications, and case examples. Participation by industries will be encouraged, as will joint workshops with the Department of Human Resources regarding solid and hazardous waste.
5. Conduct a public information program describing the Pollution Prevention Program and initiate a bi-monthly newsletter.
6. Identify and compile case studies on pollution prevention efforts of North Carolina industries. Industries nominated for the Governor's Award of Excellence in Waste Management will provide a first step in compiling the case studies.
7. Conduct on-going survey of industrial and municipal needs and opportunities in pollution prevention. Use of a simple survey form will provide a uniform method of collecting data on such things as information needs, gaps in research, success stories, and technical assistance needs.
8. Develop a positive incentives program which encourages implementation of pollution prevention efforts. Incentives related to opportunities and constraints posed by regulations will be identified, as will economic incentives. Demonstration projects of innovative approaches will be encouraged and assisted.
9. Encourage the application of environmental auditing systems as a tool in pollution prevention. Environmental auditing is similar to financial auditing. The concept of an environmental auditing roundtable will be developed to foster public and private sector discussions on environmental auditing efforts.
10. Develop pollution prevention indices to evaluate program efforts. By effectively combining information on environmental and economic benefits into easily

understood indices, the efforts of the program can be evaluated and fine tuned. The indices could be approached initially on a prototype river basin and then expanded statewide.

11. Establish a Governor's award program for excellence in pollution prevention for industrial and municipal categories. Awards would be given to top entries of industrial and municipal examples of successful pollution prevention programs.
12. Coordinate with and provide liaison and support to public and private institutions in pollution prevention strategies.

MANAGEMENT PROGRAM NEEDED FOR UNDERGROUND STORAGE TANKS

The N. C. Department of Natural Resources and Community Development

is expected to go to the General Assembly for help in the amount of \$380,000 to address what is being viewed nationally as well as in North Carolina as an environmental time bomb.

Leaking and potentially leaking underground storage tanks constitute a serious problem for North Carolina in terms of water supply contamination. According to the NRCO, there are more than 350,000 underground storage tanks in our state used for petroleum product storage alone. Estimates are unavailable for tanks storing other products or wastes. Many of these tanks are kept in use long after the manufacturers' estimated tank life, which generally averages 15-20 years.

Incidents attributed to underground storage tank leaks are probably the most often-reported groundwater/well contamination problem. Over 100 gasoline-contaminated wells are reported annually to the N. C. Department of Human Resources.

At present there is no national or state program to direct tank management. On a national level, EPA has allocated \$1.25 million for the study of leaking underground storage tanks (called the LUST program). An agency-wide task force has been assembled, and six people have been assigned to the project. Five areas will be addressed by the group: (1) literature search, (2) model legislation to provide guidance to states considering underground storage tank legislation, (3) a statistical survey or inventory of underground storage tanks, (4) tank construction standards, and (5) liability education for owners of tanks.

At the state level, a proposed program to manage underground storage tanks would require an estimated \$380,000. The following steps have been recommended:

1. Inventory and assess status of N. C. state-owned underground storage tanks.
2. Public information and technology transfer.
3. Develop and fund an underground storage tank emergency response strategy and management team.
4. Proceed immediately to establish by legislative action a comprehensive management program.

SUPPORT GROWING FOR PHOSPHATE DETERGENT BAN

The prospect of a statewide phosphate detergent ban has become a familiar one to

North Carolinians in recent months as both sides in the debate over the ban have aired their views. A legislative study commission is looking at the pros and cons of a "clean detergent bill" that would restrict phosphorus levels in household laundry products. The purpose would be to help reduce levels of phosphorus entering the state's waters in municipal treatment plant effluent.

The Soap and Detergent Association (SDA), which represents a number of detergent manufacturers, opposes a ban on phosphate detergent. The SDA warns of high costs to consumers forced to use nonphosphate detergents, due to increased use of hot water and additives, wear and tear on clothes and machinery, and expense of nonphosphate detergents.

State water quality officials, on the other hand, favor a phosphate detergent ban as one component of a strategy to reduce nutrient inputs to rivers, lakes, and estuaries. They cite the high cost to local governments of an alternate method of reducing phosphorus levels: removal of the phosphorus at the wastewater treatment plant (WWTP). Support for the ban is gaining support from local governments and citizen groups, anxious to improve water quality but not to shoulder the expense of constructing and operating phosphorus removal equipment at the WWTP. The City of Raleigh estimates that removal at the WWTP would increase water-sewer costs to each household by \$48 per year.

In addition, statements from the SDA concerning higher costs of using nonphosphate detergents have been challenged. The N. C. Department of Natural Resources and Community Development disputes SDA claims that using the nonphosphates in North Carolina would cost consumers \$60 million statewide, or \$26.18 per household per year. According to NRCDC's evaluation of data, there would be little or no cost to the consumer.

The SDA used results of surveys by the detergent industries on phosphate vs. nonphosphate detergent costs to show that a ban on phosphates would mean higher costs in three areas: increased energy and additive costs, increased fabric wear, and an increase in machine damage. NRCDC found flaws in the studies, however, such as failure to address such factors as water hardness. In the studies on fabric wear, for instance, water hardness was 3-6 times higher than the North Carolina average, and the nonphosphate detergents evaluated were not representative of available substitutes, according to the department.

NRCDC cites experience in other states (six have enacted statewide phosphate detergent bans) showing that exclusive use of nonphosphates will reduce phosphorus levels in municipal WWTP effluent by 25-30 percent. This reduction could in some North Carolina cases provide sufficient water quality protection. In more severe cases, where removal of phosphorus at the treatment plant is also necessary, it would reduce removal costs. The department also points out the significance of phosphorus inputs from municipal WWTPs. The phosphorus is in a form more readily available for use by algae than that from other sources. The relative contribution of phosphorus from WWTPs varies in each North Carolina water basin (e.g., 17 percent in the Chowan River, 42 percent each in Falls Lake and the Neuse River, and 60 percent for Jordan Lake).

NRCDC officials believe that restricting phosphorus levels in detergents, while not a panacea for the state's nutrient problems, would be a "cost-effective first step" in reducing excess phosphorus levels in surface waters. Other sources of the nutrient are also being addressed, such as industrial dischargers and stormwater runoff from farms, forests, and urban areas.

The matter of a phosphate detergent ban is expected to be addressed in the upcoming session of the legislature.

REPORT PUBLISHED ON GROUNDWATER
OF CAPE FEAR RIVER BASIN

Groundwater is the
topic of one report
in the series pro-

duced by the Cape Fear River Basin Study, conducted from 1981-1983.

Ground-water Supply Potential and Procedures for Well-Site Selection in the Upper Cape Fear River Basin,

North Carolina was prepared by Charles C. Daniel, III, and N. Bonar Sharpless of the U. S. Geological Survey. It relates findings of a study by USGS, as part of the larger Cape Fear study, to evaluate groundwater as a source of large supplies for the upper Cape Fear basin. The report describes the most favorable areas for high-yield wells (50 gal/min or greater); estimates the total groundwater availability both in storage and from recharge; and describes a site-selection procedure for wells that is based on bedrock lithology, geomorphic analysis to locate fractures, and reconnaissance mapping to locate areas of thick regolith and a high water table.

The authors note the attractiveness of groundwater as a source of supply in areas of North Carolina's Piedmont province such as the upper Cape Fear basin. Its cost of development is relatively low; also, it is generally of good chemical quality and requires little treatment. Because of the large quantity of water in storage, the groundwater system usually can sustain moderate yields during annual drought periods. Use of groundwater generally permits other land-use activities if they do not impede the infiltration of recharge or diminish water quality.

Although very large amounts of groundwater are potentially available in the Piedmont and Blue Ridge provinces of North Carolina, the amount actually used is very small (about 200 mgd), according to the report. In these provinces, groundwater is stored in the regolith and the underlying fractured bedrock. The regolith is the layer of loose material that forms the earth's surface. It has 20 to 50 times the water-storing capacity of the bedrock. Storage capacity within fractures in the bedrock is low, and below a depth of 400 feet is nearly zero. In the upper Cape Fear basin, average thickness of the regolith is about 50 feet, and the average depth to the water table is 15 feet. Given that the remaining 35 feet is saturated with water and has a 20 percent drainable porosity, each square mile contains an estimated 1.5 billion gallons of water, some of which drains to springs, streams, lakes, and wells. Due to seasonal changes in the water table, the amount of water in storage can vary from about 1.3 to 1.7 billion gallons per square mile.

Drilling of test wells demonstrated the usefulness of site-selection criteria for locating, in selected geologic units, wells with above-average yields that penetrated zones of highly fractured rock at sites with thick regolith and a high water table.

This study was conducted in cooperation with the N. C. Department of Natural Resources and Community Development, sponsors, along with the U. S. Water Resources Council, of the Cape Fear study. Copies of the report may be obtained from the Office of Water Resources, NRCDC, 1155 Archdale Building, P. O. Box 27687, Raleigh, NC 27611. Tel. (919) 733-4064.

'ESTUARINE PROFILE' CONDENSES,
SYNTHESIZES INFORMATION ON
ALBEMARLE SOUND

The U. S. Fish and Wildlife Service has published a report that profiles Albemarle Sound and offers a "state-of-the-art synthesis" of all available information on the sound, "especially that critical to managing the estuary."

The report is the first in a series of ecological profiles of selected estuaries of the United States. It condenses and synthesizes scientific literature and data on Albemarle Sound. Included in the profile are treatments of the biological communities in the sound and their ecological interrelationships within the

watershed, as well as treatments of the geological and hydrological characteristics. Management issues, including eutrophication, fisheries, and freshwater flow, are also discussed.

Authors of the report, titled The Ecology of Albemarle Sound, North Carolina: An Estuarine Profile, are B. J. Copeland and R. G. Hodson of the UNC Sea Grant College Program, S. R. Riggs of the East Carolina University Department of Geology, and J. E. Easley, Jr., of the N. C. State University Department of Economics and Business.

An estuarine profile on the Pamlico River Estuary is planned for later this year. Requests for copies of the Albemarle Sound profile should be addressed to Information Transfer Specialist, National Coastal Ecosystems Team, U. S. Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, Louisiana 70458.

SOIL AND WATER '84 UPDATE: Soil and Water '84 received a boost in February when the theme OF STATE FAIR of the North Carolina

State Fair was changed to "Conservation--Our Agricultural Heritage." The Steering Committee of the year-long observance also accepted Agriculture Commissioner Jim Graham's offer to use an entire 80-foot geodesic dome for a conservation display at the October fair. Funds are now being raised for this large exhibit.

Individual Soil and Water Conservation districts are scheduling many activities. The Wake District kicked off its program February 15 with a conservation workshop for farmers in the Falls Lake Watershed that covered conservation services available, fertilizer and pesticide uses, forest management, and even ASCS cost-share assistance. The Wake District is also providing speakers on conservation with several appearances booked. Other activities underway or planned by districts around the state include media public service announcements, conservation tillage displays, and a special newsletter on Soil and Water '84.

Large requests for materials (bumper stickers, stationery, and other supplies) are being received by the Division of Soil and Water Conservation in Raleigh. The Division has also prepared a 10-minute slide tape show titled "Soil and Water '84" which will be made available for use by Soil and Water Conservation Districts and the public. For details contact Laura Wells with the Division of Soil and Water Conservation, NRCDC, P. O. Box 27687, Raleigh, NC 27611.

CITIZENS ENCOURAGED TO REPORT 'ENVIRONMENTAL HORRORS'

citizens to report "environmental horrors" such as severe erosion at construction sites, chemical spills or dumping, and dredging or filling of wetlands, instead of just assuming that the proper authorities already know about them.

"The average citizen has no idea how badly we need his or her help in controlling environmental violations," one official says in the article. "This is a big state, and our people simply can't cover it without help. People who hunt, fish, hike or travel are our eyes. If they see anything they consider questionable, they need to report it right away. If the problem is one we already know about, no harm is done."

A current example of a major problem in our state is destructive land-development projects in the mountains,

where construction of second homes and recreational developments is flourishing. Randy Cotten, information and education coordinator for the N. C. Division of Land Resources, stated in the article that, "These are not small-scale developments built by local contractors. Most of the problems are caused by out-of-state development companies which are often based in Florida. These companies buy whole mountainsides and quickly cut many miles of substandard roads which soon wash out. Lots in these developments are often sold to customers sight-unseen, and many of the customers are elderly or retired people."

The companies cut logging roads and harvest timber from the homesites, claiming to be logging operations in order to avoid complying with the N. C. Sedimentation Pollution Control Act regulations. The act excludes forestry and agriculture.

Another problem that citizens are urged to report is that of abandoned chemical-dump sites, open dumps, or demolition dumps (generally used by contractors or developers to dispose of building materials, sometimes including harmful chemicals). North Carolina's major generators of hazardous wastes (over 2,200 pounds per month) are required to account for their wastes (where and how they are disposed of) by filing manifests with the Solid and Hazardous Waste Branch of the N. C. Division of Health Services. However, there is no such mechanism to monitor wastes from the many smaller generators, so the waste can end up polluting land and water.

A third common environmental violation mentioned in the article is the destruction of wetlands. Often, freshwater wetlands are cleared and drained or filled, without a permit, to create "waterfront lots" or shopping centers. "Who would have the gall to operate a piece of equipment as big as a dragline in plain sight if it weren't legal? The answer is 'lots of folks'--it happens all the time," the article states.

A list of numbers is given for reporting violations of environmental laws:

- Hazardous waste sites and illegal dumps--919/733-2178
- Oil and chemical spills, water pollution, fish kills--1-800-662-7956
- Mountain developments and siltation problems--919/733-3833
- Dune destruction and filling of coastal marshes--919/733-2293
- Destruction and filling of freshwater wetlands--919/343-4631
- Wildlife violations and fish kills--1-800-662-7137
- Marine fisheries violations--1-800-662-7956

SEDIMENTATION PROBLEMS TO BE TOPIC OF WESTERN N.C. WORKSHOPS

Western North Carolina officials will have an opportunity to attend either of two workshops in April focusing on sedimentation problems in the mountains.

The workshops are aimed toward informing local government officials about the recent increase in mountain sedimentation problems resulting from substandard developments. Current laws and options for reducing mountain sedimentation will be a key focus of the workshops.

The first workshop will be held April 5-6 at Appalachian State University in Boone. This workshop will be sponsored by Appalachian State University, the North Carolina Sedimentation Control Commission, the Northwest North Carolina Development Association and

the Appalachian Consortium. For information regarding registration contact: Dr. Ole Gade, Rankin Science Building, Appalachian State University, Boone, NC 28607.

The second workshop will be held April 25 at the Terrace Hotel in Lake Junaluska. This workshop will be sponsored by Western North Carolina Tomorrow and the North Carolina Sedimentation Control Commission. For information regarding registration contact: Western North Carolina Tomorrow, Center for Improving Mountain Living, Western Carolina University, Cullowhee, NC 28723.

URBAN PROJECTS PART OF VIRGINIA CHESAPEAKE BAY CLEAN-UP PROPOSAL

A \$6 million clean-up program proposed by Virginia for the Chesapeake Bay would allot \$750,000 for control of urban

nonpoint source pollution, an amount which could be used for such efforts as hiring local "urban conservation specialists," conducting research and demonstration programs on urban best management practices (BMPs), and a grant program for urban streambank stabilization.

Virginia's Governor Robb announced that the Chesapeake Bay Initiative Proposal would be part of his 1984-86 biennium budget proposal, according to the Virginia Soil and Water Conservation Commission's E & S Bulletin. That commission is the tentative lead agency to plan and implement the urban portion of the clean-up.

A preliminary plan by the commission has three elements. One would provide 75-percent cost-share grants to conservation districts with the most urbanizing localities for the employment of urban conservation specialists. These specialists would provide technical assistance toward the implementation of local erosion and sediment control and stormwater management programs.

A second element would be to install urban BMPs in actual field situations and monitor their effectiveness. One already identified is a porous asphalt pavement installation. In a third element of the plan, projects such as vegetative streambank stabilization or revegetation of abandoned, denuded land would be considered for cost-sharing assistance.

NATIONAL WATER RESEARCH CENTER CONSIDERED

The Council for Environmental Quality (CEQ) has been directed by the Congress to develop

recommendations by September 30 for the possible organizational structures and goals for a national water resources research center and information clearinghouse. Congress required that the assessment for a center be made by a university-based research organization. The Chesapeake Research Consortium, representing three universities and the Smithsonian Institution, is expected to conduct a feasibility study. Efforts will be made to define a national research center's mission and how it could coordinate research being done by existing organizations.

According to CEQ the national center could deal with the scientific, economic, social, and political aspects of policies affecting groundwater, surface waters and estuaries. Topics the center could address include water pollution control, conservation, drought, flooding and water emergencies.

According to Council Chairman A. Alvan Hill, the Council will hold public meetings and seek comments on how the center and information clearinghouse should be organized.

NEW INSTITUTE REPORT

A Survey of Potential Population Exposures to Chemical Contaminants Present in Unprotected Surface Water Supplies in North Carolina by Alvis G. Turner, Francis A. DiGiano

and Patricia M. DeRose, Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina at Chapel Hill.

The purpose of this research was to use existing data on public water supplies, municipal and industrial wastewater discharges, and demographic information to identify those surface water supplies in North Carolina which have the greatest potential for contamination with organic chemicals and which, if contaminated, would expose the largest number of people. This information was used to create a new computer data base which should be useful to investigators and regulatory authorities interested in drinking water quality and human risk.

Computer cartography was used to provide a spatial analysis (mapping) of major NPDES point source discharges and surface water supplies by county and by river basin. These maps provide a graphic representation of the spatial relationships between point source discharges and water supply extraction sources.

Currently, little organized information is available to establish a complete chemical profile of each point source of wastewater discharge. Even less is known about the chemicals contributed by nonpoint sources such as agricultural and urban runoff. This preliminary study suggests the need for an integrated data management system linking surface water supply systems to all potential sources of chemical contamination. The specific chemicals entering surface waters must be estimated or, better yet, measured so that potential risks may be evaluated.

A highlight of this project was its ability to organize existing data in a manner which would provide a base for future investigations on surface and drinking water quality and human exposure. As a first step, the organic chemical contaminants in raw water supplies extracted from those surface waters considered most vulnerable to upstream wastewater discharges should be identified and their removal by water treatment measured.

This report, No. 213, is free to residents of North Carolina and may be purchased by nonresidents for a fee of \$8 by writing to the Institute.

CONFERENCES AND WORKSHOPS

Managing Contaminated Ground Water - North

Carolina makes much use of its ground water, and some of its ground water is being contaminated by seepage from sanitary landfills; industrial lagoons and old landfills; buried tanks and pipe lines; and septic tanks. As a result of this seepage and the current interest in clean water, there is interest in the problems of locating and drilling sampling wells, taking samples, interpreting the results, understanding the behavior of contaminated water in the underground structures, and figuring out what to do about contaminated ground water when it is found.

This two-day program on managing contaminated ground water has been designed to bring two of North America's leading engineers involved in managing contaminated ground water: Professor John Cherry of the University of Waterloo and Professor George Pinder of Princeton University, to Raleigh where they will be joined by knowledgeable North Carolinians in presenting the program.

This program should be of interest to hydrologists, geologists, civil engineers, well drillers, environmental managers, consulting engineers, and government officials concerned with managing contaminated ground water.

This course will be held April 10-11, 1984, from 8:30 a.m. to 4:30 p.m. at McKimmon Center, NCSU, Raleigh, NC. For more information on program content and objectives, contact Jerome Kohl at (919) 737-2303. For information on registration contact Woody Fairbrother or Michelle Howell at (919) 737-2261.

Options for Management of Electroplating Sludges - In this program North Carolina Electroplaters and Metal Finishers report on their activities aimed at eliminating or minimizing burial of metal-containing sludges.

This program will be held at McKimmon Center in Raleigh on May 30 and at the Holiday Inn Woodlawn in Charlotte on May 31, 1984. For more information and a registration form, contact: North Carolina State University, Division of Life Long Education, P. O. Box 5125, Raleigh, NC 27695-5125, ATTN: Woody Fairbrother/Michelle Howell, Phone: (919) 737-2261.

Water Resources Systems - Short Course - This is a one-week short course for engineers and public officials interested in Water Resources Systems to be held May 7-11, 1984, at Case Western Reserve University in Cleveland, Ohio.

The purpose of the short course is to present the state-of-the-art in the field of large-scale systems engineering as applied to the planning and management of water and related land resource systems. In particular to discuss the applications of high technology, decomposition and higher level coordination techniques to water resource systems.

For registration details write M. A. Pelot, Systems Engineering, Rm. 612C Crawford Bldg., Case Western Reserve University, Cleveland, OH 44106. Telephone (216) 368-4492 or 4493.

The National Water Well Association is presenting its 6th Groundwater Heat Pump Conference April 9-11 at Ohio State University in Columbus. Topics to be covered in discussions and workshops include the economics and energy use of heat pumps, calculating heating and cooling loads, gathering water quality information, testing well and aquifer performance, installing and servicing heat pumps, and case histories. Contact NWWA, GWHP 1984, 500 W. Wilson Bridge Rd., Worthington, OH 43085.

The American Society for Testing and Materials will hold its Eighth Symposium on Aquatic Toxicology April 15-17 in Fort Mitchell, Kentucky. Topics will include new concepts in environmental assessment, prediction techniques, and research needs. There is a \$35 registration

fee for the symposium. For more information, contact Anne McKlindon, ASTM Standards Development Division, 1916 Race St., Philadelphia, PA 19103. Telephone (215) 299-5490.

WATER RESOURCES CONDITIONS IN NORTH CAROLINA

Average streamflow increased and was above normal statewide. Heavy

rain on February 14 caused moderate flooding in the Piedmont province and minor overbank flooding in the mountains and Coastal Plain province. Mean monthly flows at selected stations, as compared to long-term means, were: French Broad River at Asheville (mountains), 141 percent; South Yadkin River near Mocksville (Piedmont), 176 percent; and Contentnea Creek at Hookerton (Coastal Plain), 114 percent.

Ground-water levels in shallow wells rose across the state. During February, water levels were 5 to 6 feet above normal in the mountains, 3 to 6 feet above normal in the Piedmont province, and 1 to 2 feet above normal in the Coastal Plain province. The water levels in the Blantyre well, Transylvania County, and in the Mocksville well, Davie County, were at record high levels for February.

. . . U. S. Geological Survey

POSITION AVAILABLE

Computer Programmer/North Carolina State University.

Extension Specialist in Biological and Agricultural Engineering. M.S. degree preferred, B.S. required, with strong experience in computer programming and data base management in addition to a working knowledge of statistics. Ability to program in a structured language and experience with SAS preferred. The person selected will interact with environmental scientists to build and analyze a data base on water quality programs nationwide. Salary range \$20,000 - \$25,000 based on experience. Send resume and the names of three references by April 15, 1984, to:

Dr. Michael D. Smolen
National Water Quality Evaluation Project
622 Downtown Boulevard
Raleigh, NC 27603

North Carolina State University is an equal opportunity/affirmative action employer.

NEW PUBLICATIONS RECEIVED BY THE INSTITUTE

(Residents of North Carolina may borrow these from the Institute for a two-week period. Where individual copies are desired, readers are encouraged to request copies from the organization issuing the publication. The addresses are provided by the NEWS for this purpose.)

Water Resources Planning

"A Model Code on Planning for and Allocations of Water to Public Water Systems," (#96), 1/84, by V. A. Sikora, WRRRC, U. of TN, 428 S. Stadium Hall, Knoxville, TN 37996-0750. (06A)

Water Quality Management

"An Evaluation of Trends in the Acidity of Precipitation and the Related Acidification of Surface Water in North America," (USGS Water-Supply Paper 2249), avail. from Branch of Distribution, Text Products Section, USGS, 604 S. Pickett St., Alexandria, VA 22304, price - \$2.75. (05C)

"In-Situ and On-site Biodegradation of Industrial Landfill Leachate," 6/83, by R.C. Ahlert, et al., Center for Coastal and Env. Studies, Rutgers Univ., Doolittle Hall--Busch Campus, New Brunswick, NJ 08903. (05B)

"Desalination: A South African Perspective," 9/83, by Water Research Commission, PO Box 824, Pretoria 002. (03A)

"Purgeable Organic in Tennessee Groundwater: A Problem Assessment," (#99), 12/83, by R.B. Robinson, et al., WRRRC, U. of TN, 428 S. Stadium Hall, Knoxville, TN 37996-0750. (05A)

"Fluxes of Heavy Metals in Delaware River Freshwater Tidal Wetlands," 12/83, by R.L. Simpson, et al., Center for Coastal and Env. Studies, Rutgers Univ., Doolittle Hall--Busch Campus, New Brunswick, NJ 08903. (05A)

"Mercury and Other Metals in the Fish of B. Everett Jordan Lake, NC," (#83 11), 12/83, by DEM, NCDNRCD, PO Box 27687, Raleigh, NC 27611. (05A)

"Relationships Between Phytoplankton Growth Rates and Nutrient Dynamics in Lake Norman, NC," (DUKE PWR/82-01), 1982, by M.S. Rodriguez, Production Environmental Services, Production Support Department, Duke Power Co., Rt. 4, Box 531 Huntersville, NC 28078. (021)

"National Water Quality Inventory--1982 Report to Congress," (EPA 440/2-84-006), 2/84, by USEPA, Office of Water Regulations and Standards (WH-551), Washington, DC 20460. (EPA)

"Water Reuse in the Coastal Plain of New Jersey--A Case Study," 5/83, by R.C. Ahlert, Center for Coastal and Env. Studies, Rutgers Univ., Doolittle Hall--Busch Campus, New Brunswick, NJ 08903. (05D)

Water Quantity Management

"Flood Control Effectiveness of Systems of Dual Purpose Detention Basins," 1/83, by W. Whipple, Jr., Center for Coastal and Env. Studies, Rutgers Univ., Doolittle Hall--Busch Campus, New Brunswick, NJ 08903. (04A)

"Regulation of Flood Hazard Areas to Reduce Flood Losses, Vol. 3," 3/82, by J. A. Kusler, for US Water Resources Council, Washington, DC 20240. (04A)

"Ground-Water Resources of the United States," 1983, compiled by D. K. Todd, avail. from Premier Press, PO Box 4428, Berkeley, CA 94704, Price - \$39.00, (02F)

NOTE: Two thousand one hundred and twenty-five copies of this newsletter were printed at a cost of \$723.20, or \$0.34 per copy.

SPECIAL

Groundwater Quality Management

by

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In this presentation, I would like to address the broad subject of groundwater quality management. To provide an overview, we will first look at the extent of national groundwater problems, then national policy being proposed to address these problems. Moving to the state level, we will compare selected state strategies for managing groundwater, then focus on the approach the State of North Carolina is taking.

National Groundwater Problems

Most of us are aware of the increased national attention being given to groundwater resources. That attention, in some instances, has risen to practically a national hysteria, with citizens expressing understandable concern over the safety of their water supplies. Underlying that concern are some very real and complex problems which transcend the more visible issue of polluted groundwater.

As environmental officials and policy makers, we need to understand these problems and seek solutions which will protect and preserve our nation's groundwater resources. Water quality-related problems can be grouped into four categories: Groundwater Contamination, Risk Assessment, Inadequate Database, and Diffuse Authority. Before discussing these problems, however, I would like to briefly review some facts and figures which dramatically point out the importance of groundwater quality to the long-term well being of this country.

On any given day around 90 billion gallons of groundwater are withdrawn from aquifers across the country. Of this amount, about 65 percent is used for irrigated agriculture, the remainder being used by water supplies and industry. At present, nearly half the population of the United States uses groundwater from wells or springs as their primary source of drinking water. Looking at municipal public drinking water supply, about 36 percent of the water comes from the ground. And of the major U. S. cities, 75 percent depend on groundwater for most of their supply.¹

Since 1950, groundwater use has been growing at an annual average rate of four percent, and with increased population growth and industrialization, this growth is expected to continue. Simply stated, continued use of the country's groundwater resources is becoming increasingly dependent on the prudent management of these resources.²

Groundwater contamination is the most visible of the problems confronting management at the present time. Most of you have heard the stories of well pollution from various sections of the country. As an example, wells providing water to more than two million people in 36 communities on Long Island, New York, have been closed.³

The sources of groundwater contamination are varied, and as has been reported in recent articles, our methods of disposing of society's waste have been contributing to the pollution of groundwater over the years. Waste has been spread on the ground, placed in landfills and lagoons, and actually injected into the ground. Our cesspools, storage tanks, and sewers are buried beneath the ground, and fertilizers and pesticides are sprayed over the landscape. Through leaks, spills, leaches, and intentional discharges, these materials eventually percolate into aquifers, contaminating groundwaters.

Although there has been no national survey to determine the extent of these problems, incidents of contamination have been reported from every state. In California public health officials closed 39 public wells supplying water to more than 400,000 people in 13 cities because of trichloroethylene contamination, a chemical that is known to cause cancer in laboratory mice. In Colorado the disposal of pesticide byproducts in unlined holding ponds outside Denver has led to the contamination of 30 square miles of a shallow water aquifer. And even in rural areas, such as Gray Maine, sixteen private drinking wells were discovered to be contaminated with trichloroethylene, freon, acetone, xylene, dimethyl sulfide, and various alcohols. All the wells were located near an industrial waste handling facility built in 1972 to process waste oil from the Tamano oil spill in Casco Bay.⁴

Recent studies have documented that groundwater contamination is indeed a problem of national concern. The extent of this contamination is unknown, but is estimated at between one and two percent of the usable groundwater.⁵ Contamination incidents are usually very localized and vary from one region of the country to another. Human and animal wastes are among the most frequently reported sources of contamination. In California and Florida, saltwater intrusion is a major concern. Areas of the industrial Northeast have problems associated with industrial wastes, petroleum products, and landfill leachate.⁶ Farming areas experience groundwater contamination arising from agricultural practices. In general, problems depend on the type and degree of industrial and agricultural activities in a region and the population density.

A second groundwater quality problem concerns risk assessment. What does it mean when we say one to two percent of the nation's groundwater is contaminated, and how are we defining contamination? Our environmental regulatory programs have evolved from what some might call a Newtonian philosophy where things were understood in terms of black and white. Absolute standards were developed for harmful chemicals, discharges were regulated, and environmental laws passed and enforced. As long as standards were not violated, we felt our environment was protected and our water safe to drink.

Several changes have taken place in recent years which are having profound effects on environmental problems. These changes have been driven by rapidly changing technology. First, our ability to measure chemicals in the environment has been improved by several orders of magnitude. Secondly, the number of chemicals being created and used has proliferated with the changing technology. Third, several of the earlier studies extrapolating chemical effects on animals to potential threats to humans are being re-examined.⁷

What does all this mean in terms of groundwater management? It means simply that we are dealing in a very uncertain world at the present time with practically no black and white answers to a great many of the real-world problems we will be facing over the coming years. On the one hand there will be strong public outcries to restore contaminated aquifers and protect the drinking water. However, the costs for such restorations will be astronomical, and the risks of not cleaning up will be poorly defined.

William Ruckelshaus, the new Administrator of the Environmental Protection Agency, has called the solution to these problems "risk management."⁸ Until scientists have developed better means to assess risks, administrators will be facing very difficult decisions on how to solve groundwater contamination problems where little is known of the risk to humans, and very high cleanup costs are well documented.

This leads to the third category of problems facing groundwater management, inadequate databases. Over the past 15 years the thrust of environmental programs has come from the federal level in Washington. During this period automated databases have been developed with federal monies documenting pollution discharges and ambient environmental quality. Groundwater programs, however, have been primarily funded at the state level, where the resources have not been available to develop sophisticated databases. In many instances state agencies have gathered a great deal of data on groundwater conditions over the years, but have not developed sophisticated means to adequately analyze this data. Lack of adequate data on groundwater resources will further complicate an already complex groundwater management decision-making process.

The final category of problems deal with the diffuse authority for managing groundwater quality problems at both the state and federal levels. In many states groundwater programs evolved from a resource management perspective focusing on water quantity, or identifying good groundwater supplies. Pollution control, many times, was delegated to another agency or department. This has led to proliferation of agencies, each with a little piece of the pie.

This problem can best be seen, perhaps, by looking at the agencies within your own state. Recently, more federal monies, with at least some groundwater protection aspects, are becoming available. Where have those monies been going at the state level? Over ten million dollars has been made available under the Resource Conservation and Recovery Program (RCRA) to assess waste disposal problems, including groundwater contamination.⁹ Superfund monies are available to clean up such sites, and additional groundwater protection monies are being considered under the Safe Drinking Water Act. In many states drinking water, solid waste, pesticide, and emergency response programs are organizationally isolated from the state's groundwater program, and a coordinated effort to solve mutual problems is at best a difficult process.

Coordinated management of groundwater quality problems in an arena where authority is organizationally diffused will be a major challenge of this decade.

Let me briefly summarize the groundwater quality problems of national concern. First is the problem of groundwater contamination. Although no comprehensive national studies have been done, it is estimated that one to two percent of the usable groundwater is presently contaminated, and the problem merits national concern. Sources of groundwater pollution are fairly well understood, but little is known about the extent of pollution or how to go about cleaning up the problems. Some feel that major efforts should be focused on prevention, rather than cleanup, but the risks associated with leaving the pollution in the ground are not well understood either. Thus, groundwater decision-makers are going to be increasingly involved over the coming years with risk management or making major decisions under a great degree of uncertainty. The third group of problems discussed was the lack of adequate data upon which to base decisions, and the need to develop responsive databases which can assist in evaluating complex problems groundwater managers are facing. Finally, the problems of diffused authority were mentioned. Solving of groundwater quality problems in the 1980s will require a coordinated effort in an era of scarce resources; yet, organizationally, the authority to carry out that mission is diffused among many departments and agencies in many state governments.

We have discussed groundwater concerns on a national scale; let us now consider the national strategy or policy to protect groundwater.

NATIONAL GROUNDWATER POLICY

The national groundwater policy as expressed by EPA is a result of progressive evolution which is continuing and intensifying with recognition of the importance of groundwater to the nation. The current EPA policy recognizes a serious nationwide and growing pollution problem, the magnitude of which is yet to be determined.

In the evolution process, there has not been a direct approach to groundwater quality management by EPA, and no single, comprehensive program exists. Groundwater problems are being addressed in part through a patchwork of federal programs that include: Clean Water Act (CWA) 1972 Amendments, Safe Drinking Water Act (SDWA-UIC) 1974, Resource Conservation and Recovery Act (RCRA) 1976, Toxic Substances Control Act (TSCA) 1976, Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 1976, and Superfund Act (CERCLA) 1980.

The Clean Water Act provides an opportunity for treating groundwater equally with surface water in funding and implementing protection programs.

The Safe Drinking Water Act, through the Underground Injection Control provision, controls injection of contaminants into aquifers that are sources of drinking water. It also provides for protection of aquifers designated as the sole or principal source of drinking water.

RCRA provides for protection of groundwater supplies from contamination by solid and hazardous wastes.

The Superfund Act provides for cleanup of hazardous substances and wastes that endanger health and environment.

The other laws mentioned also support groundwater quality protection.

EPA Strategy Draft - 1983

The stated long-term goal of EPA's proposed groundwater policy is: to safeguard the public health and sensitive environmental systems by protecting the quality of the groundwater, taking into consideration current and projected future uses to the extent feasible and consistent with statutory objectives. This goal is very vague and open ended, which is probably necessary to accommodate the policies of all the states.

The current national strategy may be outlined as follows:

A. The Role of the States

EPA has generally determined that the states should have the leading role in groundwater management. This is appropriate and should result in accomplishment of both EPA and state goals much more smoothly and effectively than trying to establish a uniform strategy for all states.

B. Development of State Strategies

EPA will encourage states to develop groundwater management strategies, which are essential for sound management. Strategy development and implementation certainly should be eligible for grant support, and substantial support will be needed if effective management of the groundwater is to be accomplished. The magnitude of the task involved in protecting groundwater quality has not yet been given much attention and is much greater than is generally realized.

C. Coordination of Groundwater Protection Activities

EPA proposes to work toward a high level of coordination between EPA and State programs, EPA and federal agencies, and between the State agencies involved in groundwater activities. Such coordination is essential for achieving the goals of both EPA and the State.

D. Coordination of the Implementation of the EPA Regulations

EPA intends to develop guidelines or factors to be considered in groundwater protection, such as aquifer character and use, and will try to meet EPA regulations with state strategies.

E. Defining the Nature and Extent of Groundwater Contamination

EPA recognizes that identification of all instances of groundwater pollution is not feasible, but will cooperate with the states in developing methodology of assessing problems by categories. This would eventually provide a general understanding of the magnitude of the problem.

F. Groundwater Research

This is an important element of the federal strategy and another area where the states need assistance. The results of research activities should be made available to the states as promptly as possible.

G. Groundwater Use

EPA recognizes a connection between water quantity and quality and leaves jurisdiction of quantity to the states. This is a substantial change from previous strategy proposals. However, state strategies must incorporate both quantity and quality in joint management.

There is a growing recognition and concern that the groundwaters have not been adequately addressed by EPA and that a strong national policy is needed to support the efforts of the states. The need for a comprehensive strategy to provide adequate protection of the groundwaters is certainly apparent and cannot be overemphasized at this time.

Reflection of national concern for comprehensive groundwater protection is seen in recent legislation introduced in Congress that would provide funds in the amount of \$10 million specifically for groundwater planning. In addition, the Underground Injection Control program would be expanded to include surface impoundments of wastes, which is the greatest threat to groundwater quality in most states. Funding for this program would be substantially increased.

STATE GROUNDWATER STRATEGIES

Now that we have looked at the problem in the national perspective, let us briefly review the different state approaches to managing their groundwater resources and what strategy several have adopted.

State efforts to protect or manage the groundwaters fall into two broad categories: (1) Control of the pollution source, and (2) management of the resource.

Control of the Groundwater Pollution Source

All fifty states have one or more programs to limit, prohibit, record, clean up, or otherwise control activities that result in the discharge of pollutants to the groundwaters. These programs include: Underground Injection Control, Clean Water Act-Based Permits Applying to Discharges to the Groundwaters, Toxic and Hazardous Waste Control

Programs, Superfund or Related Clean-up Activities, Landfill Regulations, Water Supply Protection, and Groundwater Protection Elements in Minerals Development Permits, such as Mining or Oil and Gas Production.

These programs to protect the groundwaters from specific polluting activities were generally enacted in the fifteen-year period from the mid-fifties to the early seventies. In this period, groundwater protection took a giant step from its previous relegation to the out-of-sight, out-of-mind category. The states as a whole do a good job in regulating a few major activities that are widely acknowledged to result in groundwater pollution.

Management of the Resource: Classification Systems and Related Strategies

In the later 1970s, some states began to feel that the activity-related approach to groundwater protection was a bit too piecemeal to provide generalized resource management; that while numerous agencies watched pollution from the activities each regulated, no one really watched "the groundwaters."

At least twelve states have adopted strategies to manage groundwaters as a resource. These strategies generally involve a series of classifications of the groundwaters or aquifers; and an accompanying quality standard, discharge control provision, or similar limitation to protect a specified level of groundwater quality. Twelve states have adopted this broader resource management approach in addition to activity controls. These are: Connecticut, Florida, Maine, Michigan, Missouri, Nebraska, North Carolina, New Jersey, New Mexico, New York, Virginia, and Wyoming.

There are two distinct policies in the broader area of groundwater management: groundwater as a multi-use resource or groundwater as a source of drinking water.

A. Groundwater as a Multi-use Resource

A number of states with groundwater classification systems have adopted the policy that the groundwaters and the subsurface may be available for the receipt of wastes. The classification systems and the standards in these states denote drinking water aquifers or portions thereof and also allow disposal areas where the use of the groundwaters is for "other than drinking water purposes." The seven multi-use groundwater management states include: Florida, Michigan, New Jersey, Nebraska, New York, New Mexico, and Wyoming.

B. Non-degradation States

Other states have as a formal policy that the only or the overwhelmingly predominant acceptable use of the groundwaters is as a source of drinking water in an untreated state and have promulgated standards to protect groundwater quality to that level. The five non-degradation states are: North Carolina, Virginia, Connecticut, Maine, and Missouri.

Four different approaches to groundwater management are capsulized in a look at the programs of California, Massachusetts, Missouri, and Maine.

1. California - Riparian Rights; Regional Control; A Discharge Control Approach

Protection of the quality of the groundwater in California is governed by nine regional water quality boards established by the Porter-Cologne Act. Each board has the authority to manage the discharge of "nonsewerable wastes to land" in its own region. California regulations emphasize control through careful siting of disposal facilities, rather than the broader control of the quality of the groundwater resource.

Though the issue is not quantity, the quantity doctrine of Riparian Rights is sufficiently strong in California and other primarily western states that it is worth mentioning. In California groundwater rights are governed by the "Correlative Rights Doctrine." Under this doctrine, each overlying landowner is entitled to make reasonable beneficial use of the groundwater, with a priority equal to all other overlying users. With the exception of certain adjudicated groundwater basins in the southern part of the state, permits are not required nor are limits set for groundwater extraction for beneficial uses. Some attitudes towards quality protection may stem from the strong general doctrine that the landowner should be able to do pretty much as he likes with his property and the underlying groundwaters.

2. Massachusetts - Purchasing Protection

In 1982 Massachusetts passed the Aquifer Land Acquisition Program which provides funds to assist cities, towns, and public water supply districts in purchasing lands, waters, and easements to protect existing and potential public water supply groundwaters. Grants of up to \$500,000 can be made under this program.

3. Missouri - Quality Control Through Universally Applicable Effluent Limits

The State of Missouri's efforts to protect groundwater quality take the regulatory form of effluent limits for groundwater dischargers. These appear to be applicable statewide. Missouri effluent limits restrict underground or surface dischargers to discharge quality equal to the standards by the time infiltrating waters reach the top of the saturated zone. These limits are quite stringent. Allowable concentrations of most "natural" substances are expressed in micrograms per liter. All persistent bioaccumulative man-made toxic substances are prohibited.

4. Maine - The Legislature Stays Involved

In the late 1970s, the State of Maine began studying its needs in the area of groundwater quality protection. In 1979 the legislature established a commission to review the laws dealing with groundwater. The result is a classification system, tougher legal language on facility siting, and continued legislative oversight of the administration of the state's classification system. The State of Maine has a two-class system of drinking water classifications: GW-A, suitable for use as a public water supply; and GW-B, suitable for all uses other than as a public water supply. The standards of quality for GW-A waters are generally the national interim primary safe drinking water standards. For a groundwater area in Maine to receive less than GW-A protection the legislature must directly approve. 1983 legislation states that "all groundwater shall be classified as not less than GW-A, and reclassification may only be enacted by the legislature upon recommendation of the Board of Environmental Protection."

THE NORTH CAROLINA APPROACH

North Carolina faces, to a greater or lesser degree, virtually the same threats to groundwater quality that all states do. Overall, we think we may be in better shape than some because of our historically rural, predominantly agricultural-oriented population. However, population growth, associated with a shift toward an industrial economy, has caused or threatens groundwater pollution problems of increasing magnitude.

North Carolina's pollution problems fall into five categories which are, in order of severity: (1) Waste disposal facilities and practices, (2) Spills and leaks, (3) Land use practices, (4) Saltwater intrusion or encroachment, and (5) Well construction practices. Protection of the State's groundwaters from these sources or causes of pollution is the chief mission of our groundwater program. The primary goals of our program are: pollution prevention, pollution response, and resource management.

As the subject of this segment of the workshop is groundwater quality management, I will limit the remainder of this discussion to the "pollution prevention" and "pollution response" goals.

In North Carolina, as in many states, the responsibility for groundwater protection is shared primarily by agencies whose concerns are, on the one hand, public health and on the other, environmental protection. The Department of Human Resources, the public health agency in North Carolina, has the responsibility of ensuring the quality of public water supplies as they reach the consumer, while the environmental agency, the Department of Natural Resources and Community Development, is responsible for the protection of the source of the supply; that is, the groundwater environment.

The Department of Human Resources participates in the groundwater quality protection program through its administration of the RCRA and solid waste management programs. The Department of Natural Resources and Community Development is responsible for implementing the Underground Injection Control program, enforcing well construction standards, and, most importantly, establishing classifications and quality standards for the groundwaters of the state, and protecting those groundwaters accordingly.

The statute which mandates the groundwater classification system is the authority for the protection of all the waters of the state from the direct or indirect discharge of wastes. It is interesting to note that the definition of "waste" in this statute is so broad as to include almost any substance, and that the statute contains a section which expressly forbids the discharge of waste to the subsurface by means of wells.

The statute establishes the authority to issue permits for the direct or indirect discharge of wastes to classified waters by waste treatment or disposal facilities and provides for civil penalties, and judicial action where standards or permit conditions are violated. Facilities or activities which do not require permits may be regulated by the issuance of special orders and establishment of compliance schedules by the regulatory commission.

North Carolina's groundwater classifications and standards are predicated on the philosophy that:

1. Virtually all of the groundwaters are of potable quality,
2. More than half the state's population depends upon groundwater as a source of water supply, and
3. Users should expect to be able to consume groundwaters with little or no treatment required.

Based on these tenets, North Carolina has developed a quasi-nondegradation management approach based on three classifications of GA, GB, GC, two classifications for saline waters, GSA, GSB, and a restricted designation, RS.

The classifications recognize that groundwaters occurring at very shallow depths (less than 20 feet below land surface) are vulnerable to contamination, virtually impossible to protect, and vary widely in natural quality. This zone is also considered to be that in which most natural treatment occurs. For these reasons no numeric quality standards are proposed. However, contaminants may not be permitted to accumulate in a manner or to the extent that they may result in the subsequent pollution of waters having a higher classification.

Classified groundwaters will be protected from pollution from waste treatment or disposal facilities through a permitting process. Careful facility siting will be required, and facilities must include design features to minimize pollution potential. Monitoring will be required and violations will result in the establishment of compliance schedules for containment, restoration of quality, and elimination of the source of pollution. Nonpermitted activities may be addressed through special orders issued by the N. C. Environmental Management Commission. Where pollution is unavoidable and limited groundwater quality degradation is expected, after public hearing, variances to standards may be granted.

One of the major tasks facing the State is the assessment of existing pollution, and what to do about it. Where the responsible parties are identifiable, and financially able to take remedial action, such action may be required. In other instances, the polluted zone may only be identified to the public, and monitored by the State where drinking water supplies are threatened by migration of the pollution plume.

North Carolina is embarking on an ambitious program and on one which may require continuous modification and improvement as we gain a better understanding of the task ahead of us. We expect that we will not find ourselves alone in this effort and hope to profit from the experience of other states as they, in their own way, seek solutions to these same or similar issues.

CONCLUSION

To sum up, we have looked at the national scope of the groundwater issue, the federal posture, essentially one recognizing the primacy of the states along federal guidelines, various strategies adopted by selected states, and finally implementation of a groundwater protection strategy within North Carolina. By addressing areas of concern at both the federal and state level, we have attempted to provide an overview of the many aspects of groundwater quality management.

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Information sent by all individual states included herein.

ITEMS OF INTEREST:

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